

What is claimed is:

1. A display device comprising an actuator substrate having an actuator element, an optical waveguide plate, a crosspiece allowed to intervene between said optical waveguide plate and said actuator substrate for surrounding said actuator element, and a picture element assembly joined onto said actuator element, wherein:

said picture element assembly is disposed closely to, or it makes contact with said optical waveguide plate in a state of no load.

2. The display device according to claim 1, wherein a distance between said picture element assembly and said optical waveguide plate in said state of no load is not more than 30 % of a distance of separation between said picture element assembly and said optical waveguide plate in a driving state.

3. The display device according to claim 1, wherein said picture element assembly and said optical waveguide plate are allowed to make pressed contact with each other by applying a voltage having a polarity opposite to that of a voltage to be applied to said actuator element in order to separate said picture element assembly from said optical waveguide plate.

4. A display device comprising an actuator substrate having an actuator element, an optical waveguide plate, a crosspiece allowed to intervene between said optical waveguide plate and said actuator substrate for surrounding said actuator element, and a picture element assembly joined onto said actuator element, wherein:

said picture element assembly is allowed to make pressed contact with said optical waveguide plate in a state of no load.

5. The display device according to claim 4, wherein said picture element assembly is allowed to make said pressed contact with said optical waveguide plate by being urged toward said optical waveguide plate by said actuator element in said state of no load.

6. A method for producing a display device, comprising:

a step of forming a crosspiece precursor for surrounding an actuator element on any one of an optical waveguide plate and an actuator substrate having said actuator element;

a step of forming a picture element assembly precursor on any one of said actuator element and said optical waveguide plate;

a step of joining said actuator substrate and said optical waveguide plate to one another by the aid of said

picture element assembly precursor and said crosspiece precursor or a crosspiece formed by hardening said crosspiece precursor;

5 a step of hardening said picture element assembly precursor on said actuator element to form a picture element assembly; and

a step of hardening said crosspiece precursor to form said crosspiece, wherein:

10 when said step of hardening said picture element assembly precursor is carried out, hardening is performed in a state in which said actuator element is displaced, and said picture element assembly precursor abuts against said optical waveguide plate.

15 7. The method for producing said display device according to claim 6, wherein said step of hardening said crosspiece precursor is carried out prior to said step of hardening said picture element assembly precursor.

20 8. The method for producing said display device according to claim 6, wherein said picture element assembly precursor, which is formed on said optical waveguide plate in said step of forming said picture element assembly precursor, is joined onto said actuator element in said joining step.

25 9. The method for producing said display device

according to claim 6, wherein said actuator element is displaced by applying a voltage to said actuator element.

5 10. The method for producing said display device according to claim 6, further comprising:

performing a step of applying an adhesive to any one of said crosspiece precursor, said crosspiece, said actuator substrate, said optical waveguide plate, and a light-shielding layer formed on said optical waveguide plate, wherein:

10 said actuator substrate and said optical waveguide plate are joined to one another by the aid of said crosspiece precursor or said crosspiece and said picture element assembly precursor or said picture element assembly by hardening said adhesive.

11. The method for producing said display device according to claim 6, further comprising:

15 performing a step of removing any organic matter adhered to a surface of said optical waveguide plate prior to said joining step.

20 12. A method for producing a display device, comprising:

25 a step of forming a picture element assembly precursor on an actuator element of an actuator substrate having said actuator element;

5
a step of forming a crosspiece precursor for
surrounding said actuator element on any one of said
actuator substrate and an optical waveguide plate;

a step of joining said substrate and said optical
waveguide plate to one another by the aid of said crosspiece
precursor and said picture element assembly precursor or a
picture element assembly formed by hardening said picture
element assembly precursor;

a step of hardening said picture element assembly
precursor to form said picture element assembly; and

a step of hardening said crosspiece precursor to form a
crosspiece, wherein:

said picture element assembly is allowed to make
pressed contact with said optical waveguide plate in
accordance with shrinkage caused by hardening of said
crosspiece precursor.

13. The method for producing said display device
according to claim 12, wherein when said step of hardening
said picture element assembly precursor is carried out,
hardening is performed in a state in which said actuator
element is displaced, and said picture element assembly
precursor makes abutment.

14. The method for producing said display device
according to claim 12, wherein when said step of hardening
said crosspiece precursor is carried out, hardening is

performed in a state in which said actuator element is displaced, and said picture element assembly makes abutment.

5 15. The method for producing said display device according to claim 13, wherein said actuator element is displaced by applying a voltage to said actuator element.

10 16. A method for producing a display device, comprising:

15 a step of forming a crosspiece precursor for surrounding an actuator element on any one of an optical waveguide plate and an actuator substrate having said actuator element;

a step of forming a picture element assembly precursor on said optical waveguide plate;

20 a step of joining said actuator substrate and said optical waveguide plate to one another by the aid of said crosspiece precursor and said picture element assembly precursor, and arranging said picture element assembly on said actuator element;

a step of hardening said picture element assembly precursor on said actuator element to form a picture element assembly; and

25 a step of hardening said crosspiece precursor to form a crosspiece, wherein:

said picture element assembly is allowed to make pressed contact with said optical waveguide plate in

accordance with shrinkage caused by hardening of said crosspiece precursor.

5 17. The method for producing said display device according to claim 16, wherein when said step of hardening said picture element assembly precursor is carried out, hardening is performed in a state in which said actuator element is displaced, and said picture element assembly precursor makes abutment.

15 18. The method for producing said display device according to claim 16, wherein when said step of hardening said crosspiece precursor is carried out, hardening is performed in a state in which said actuator element is displaced, and said picture element assembly makes abutment.

19. The method for producing said display device according to claim 17, wherein said actuator element is displaced by applying a voltage to said actuator element.

20 20. The method for producing said display device according to claim 16, further comprising:

25 performing a step of applying an adhesive to any one of said crosspiece precursor, said crosspiece, said actuator substrate, said optical waveguide plate, and a light-shielding layer formed on said optical waveguide plate, wherein:

0374230-052909
1006250-2524769

5 said actuator substrate and said optical waveguide plate are joined to one another by the aid of said crosspiece precursor or said crosspiece and said picture element assembly precursor or said picture element assembly by hardening said adhesive.

21. The method for producing said display device according to claim 16, further comprising:

 performing a step of removing any organic matter adhered to a surface of said optical waveguide plate prior to said joining step.

22. A method for producing a display device, comprising:

15 a step of forming a crosspiece for surrounding an actuator element on any one of an optical waveguide plate and an actuator substrate having said actuator element;

20 a step of forming a picture element assembly precursor on any one of said actuator element and said optical waveguide plate;

 a step of joining said optical waveguide plate and said actuator substrate to one another by the aid of said crosspiece and said picture element assembly precursor; and

25 a step of hardening said picture element assembly precursor on said actuator element to form a picture element assembly, wherein:

 when said step of hardening said picture element

assembly precursor is carried out, hardening is performed in a state in which said actuator element is displaced, and said picture element assembly precursor abuts against said optical waveguide plate.

5

23. The method for producing said display device according to claim 22, wherein said picture element assembly precursor, which is formed on said optical waveguide plate in said step of forming said picture element assembly precursor, is joined onto said actuator element in said joining step.

24. The method for producing said display device according to claim 22, wherein said actuator element is displaced by applying a voltage to said actuator element.

25. The method for producing said display device according to claim 22, further comprising:

performing a step of applying an adhesive to any one of said crosspiece precursor, said crosspiece, said actuator substrate, said optical waveguide plate, and a light-shielding layer formed on said optical waveguide plate, wherein:

said actuator substrate and said optical waveguide plate are joined to one another by the aid of said crosspiece precursor or said crosspiece and said picture element assembly precursor or said picture element assembly

by hardening said adhesive.

26. The method for producing said display device according to claim 22, further comprising:

5 performing a step of removing any organic matter adhered to a surface of said optical waveguide plate prior to said joining step.

27. A method for producing a display device, comprising:

10 a step of forming a precursor of a part of a picture element assembly on an actuator element of an actuator substrate having said actuator element, followed by being hardened to form said part of said picture element assembly;

15 a step of forming a crosspiece precursor for surrounding said actuator element on said actuator substrate;

20 a step of defining an upper surface of said crosspiece precursor, and then hardening said crosspiece precursor to form a crosspiece;

a step of forming a precursor of another part of said picture element assembly on said part of said picture element assembly on said actuator substrate;

25 a step of joining an optical waveguide plate and said actuator substrate to one another by the aid of said crosspiece and said picture element assembly precursor; and

a step of hardening said precursor of said another part

of said picture element assembly on said actuator element to form said picture element assembly.

5 28. The method for producing said display device according to claim 27, wherein in said step of forming said crosspiece, said crosspiece precursor is hardened in a state in which said part of said picture element assembly abuts against a figuring plate member.

10 29. The method for producing said display device according to claim 27, further comprising:

15 performing a step of applying an adhesive to any one of said crosspiece precursor, said crosspiece, said actuator substrate, said optical waveguide plate, and a light-shielding layer formed on said optical waveguide plate, wherein:

20 said actuator substrate and said optical waveguide plate are joined to one another by the aid of said crosspiece precursor or said crosspiece and said picture element assembly precursor or said picture element assembly by hardening said adhesive.

25 30. The method for producing said display device according to claim 27, further comprising:

performing a step of removing any organic matter adhered to a surface of said optical waveguide plate prior to said joining step.